PATENT
Atty Docket No. KLAC0012

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	Group Art Unit: 2878
CHRISTOPHER FAIRLEY, ET AL.	Examiner: Eric J. Spears
Title: CONFOCAL WAFER INSPECTION METHOD AND APPARATUS	
Serial No.: 09/533,203	
Filed: MARCH 23, 2000	

DECLARATION UNDER 37 C.F.R. §1.131

Commissioner of Patents and Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Christopher Fairley, Tao Yi Fu, Bin-Ming Benjamin Tsai, and Scott A. Young, do hereby declare as follows:

1. We are coinventors of currently pending claims 1 through 20 and 22 through 33 of the above-identified patent application.
2. Prior to March 22, 1999, we conceived of the idea of a Confocal Wafer Inspection Method and Apparatus as described and claimed in our application. Conception and all acts described herein occurred in the United States.

3. A drawing (copy attached hereto as Exhibit 1) of one aspect of the invention, substantially illustrated as FIG. 5 of our application, was prepared by Mr. Young prior to March 22, 1999. The concept of use of a TDI sensor in the design is shown in a disclosure document prepared by Mr. Young prior to March 22, 1999 (copy attached hereto as Exhibit 2; see Section 6, point 1, "Using a fly-lens array with an offset pattern in conjunction with a TDI sensor...").

4. We submitted information regarding the substance of this invention to attorneys for assignee KLA-Tencor Corporation prior to March 22, 1999, and KLA-Tencor Corporation's attorneys worked with us in preparing a draft patent application, with preparation of the patent application commencing prior to March 22, 1999.

5. We reviewed at least one draft application prepared by KLA-Tencor Corporation's attorneys prior to March 22, 1999, and we provided substantive comments to the attorneys prior to March 22, 1999. Our attorneys completed the U.S. Provisional Patent Application based on our concept and, on information and belief, worked attentively and with appropriate care on finalizing and filing the application for a period of time beginning at a time prior to March 22, 1999. On information and belief, our attorneys worked toward completing and filing the application prior to March 22, 1999 through and until the filing date of the provisional application, March 23, 1999.

6. U.S. Provisional Patent Application Serial No. 60/125,568 was filed on March 23, 1999. Currently pending U.S. Patent Application 09/533,203 was filed on March 23, 2000 and was based on the 60/125,568 U.S. Provisional Patent application.

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The undersigned, being hereby warned that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of any application or patent issuing therefrom, declares that the facts set forth in this declaration are true, and that all statements made of his own knowledge are true and all statements made on information and belief are believed to be true.

Dated:

Christopher Fairley

Dated:

Tao Yi Fu

Dated:

Bin-Ming Benjamin Tsai

Dated:

Scott A. Young

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Dated: _____

Christopher Fairley

Dated: 4/6/04

Tao Yi Fu

Dated: _____

Bin-Ming Benjamin Tsai

Dated: _____

Scott A. Young

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Dated: _____

Christopher Fairley

Dated: _____

Tao Yi Fu

Dated: 5/23/2004

Bin-Ming Benjamin Tsai

Dated: _____

Scott A. Young

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Dated: _____

Christopher Fairley

Dated: _____

Tao Yi Fu

Dated: _____

Bin-Ming Benjamin Tsai

Dated: 3/31/04

Scott A. Young

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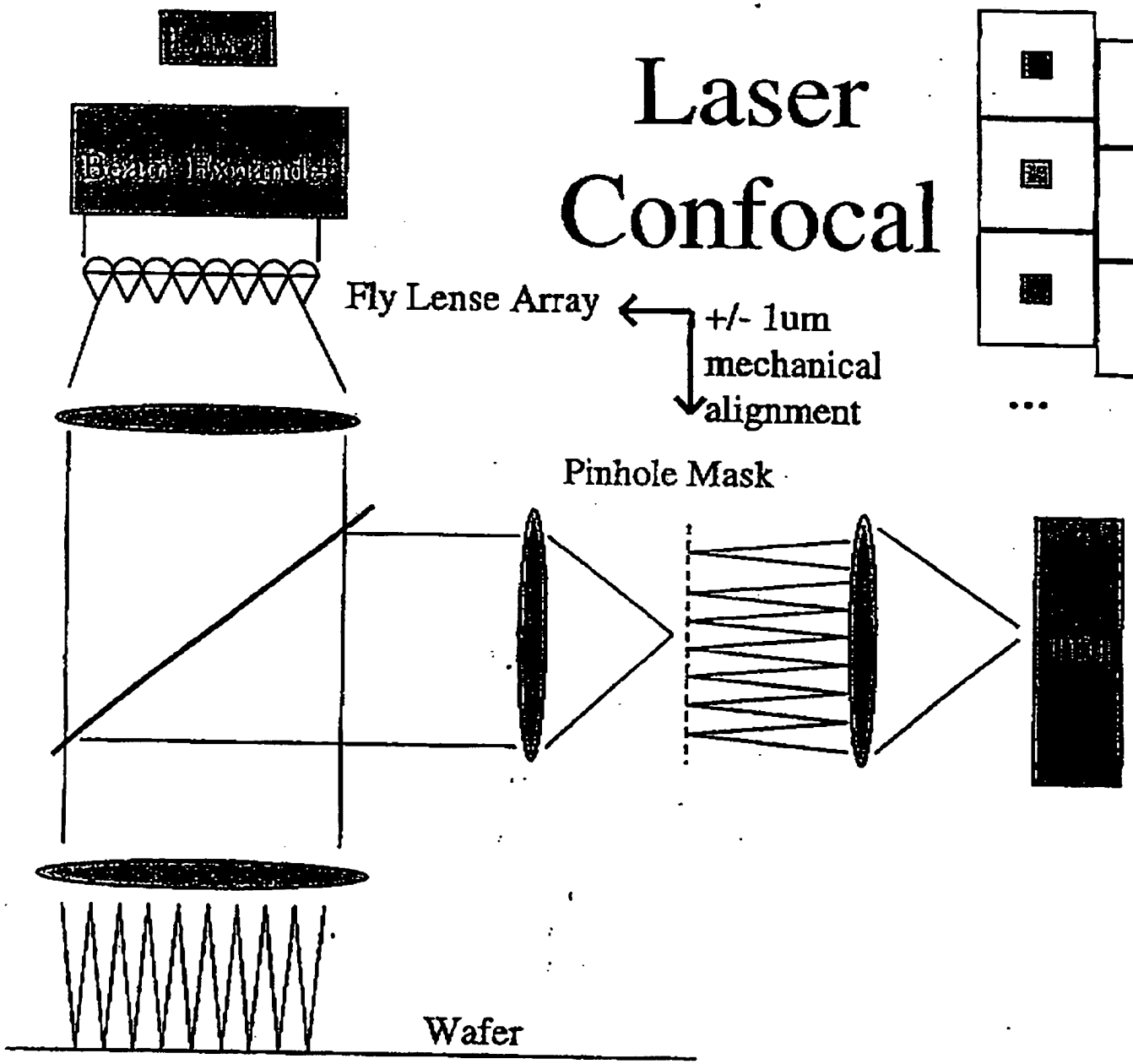
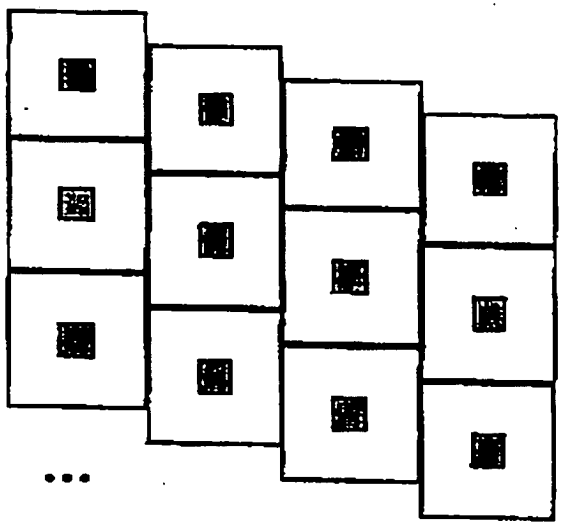
Laser Confocal





128X x 512Y fly lense
and pinhole array

A.	CONCEIVED DURING PERFORMANCE OF CUSTOMER CONTRACT?	YES	NO X
B.	CONSTRUCTED DURING PERFORMANCE OF CUSTOMER CONTRACT?	YES	NO X
C.	TESTED DURING PERFORMANCE OF CUSTOMER CONTRACT?	YES	NO X
D.	CUSTOMER NAME		CUSTOMER

THIS DESCRIPTION OF THE INVENTION SHOULD BE WRITTEN IN THE INVENTOR'S OWN WORDS AND GENERALLY SHOULD FOLLOW THE OUTLINE GIVEN BELOW. SKETCHES, PRINTS, PHOTOS AND OTHER ILLUSTRATIONS, AS WELL AS REPORTS OF ANY NATURE IN WHICH INVENTION IS REFERRED TO, IF AVAILABLE, SHOULD FORM A PART OF THIS DISCLOSURE AND REFERENCE CAN BE MADE THERETO FOR DESCRIPTION OF CONSTRUCTION AND OPERATION.

USE THE ATTACHED SHEETS TO ANSWER THE FOLLOWING QUESTIONS.
(Attach Engineering Reports or other documentation to this form.)

1. GENERAL PURPOSE OF THE INVENTION.
The invention facilitates an improvement of performance/cost of automated wafer inspection by employing methods of multiple channel confocal microscopy in conjunction with high speed, efficient, wafer illuminators and image sensors.

STATE IN GENERAL TERMS THE OBJECTS OF THE INVENTION.
1. Illuminator that creates many focused spots on wafer by use of a pinhole mask or a fly-lens array generating uniform or non-uniform illumination profiles.
2. Desired non-uniform illumination profiles can be generated with layers of binary optics.
3. Imaging system that masks these focused spots onto a sensor such as a TDI sensor that can help non-mechanically construct a continuous image.
4. A wafer is used to sequentially illuminate and image the whole wafer. Neighbor wafer die are sampled and compared in order to find manufacturing defects.

2. DESCRIBE OLD METHOD(S), IF ANY, OF PERFORMING THE FUNCTION OF THE INVENTION.
1. High-speed wafer inspection has been done using non-confocal illumination and imaging.
2. Non-laser confocal wafer inspection has been done.
3. Single spot laser confocal wafer inspection has been done.
4. Multiple mechanical polygon scanning spot laser confocal wafer inspection has been done.
5.

3. INDICATE THE DISADVANTAGES OF THE OLD METHOD(S).
1. Non-confocal wafer inspection is sensitive to wafer signals out of the depth of focus and out of the depth of application interest therefore adding noise to the sensed signal.
2. Non-laser confocal systems using a lamp must create illumination spots with an inefficient and slow pinhole since they cannot increase the intensity of the lamp arc or filament.
3. Single spot laser confocal wafer inspection is slower than multiple spot systems.
4. Multiple scanning spot systems have a difficulty aligning neighbor die for comparison due to the instability of the mechanical polygon scanning system.
5.

4. DESCRIBE THE CONSTRUCTION OF YOUR INVENTION, SHOWING THE CHANGES, ADDITIONS AND IMPROVEMENTS OVER THE OLD METHOD.
1. Laser followed by a beam expander creates an illumination field.
2. An offset fly-lens array is used convert this illumination field into an offset pattern of illumination spots. The offset-pattern is chosen specifically so that the spots can be re-combined into a continuous image by an image sensor. Binary optics can be used to create a desired illumination profile for each individual spot. These profiles could be for example bright field, dark-field, or directional dark-field.
3. The array of spots are focused onto the wafer.
4. A wafer stage moves the wafer under the spots so that any or all portions of the wafer can be imaged.
5. An imaging optics train images the spots onto a pinhole mask of the same offset pattern and alignment as the illumination fly-lens array.
6. A TDI sensor senses the spots and reconstructs a continuous image.
7. The image is digitized and compared to neighbor die images in-order to detect manufacturing defects.
8.

5. GIVE DETAILS OF THE OPERATION IF NOT ALREADY DESCRIBED UNDER 4.

6. STATE THE ADVANTAGES OF YOUR INVENTION OVER WHAT HAS BEEN DONE BEFORE.
1. Using a fly-lens array with an offset pattern in conjunction with a TDI sensor provides a system with the efficiency, speed, and stability to perform superior performance/cost wafer inspection.
2. Binary optics are used to construct a inexpensive fly-lens array with uniform or non-uniform illumination profiles which can improve the signal to noise ratio of defect detection for the application.

7. INDICATE ANY ALTERNATE METHOD OF CONSTRUCTION.
1. The spots can be focused onto the wafer through the imaging optics or around them as long as the imaging pinhole array can be correctly aligned.
2. An AOD scanning system could handle an array of spots with better mechanical stability than a polygon.
3. An arc lamp with a pinhole array could be used to create illumination spots.
4.

8. IF A JOINT INVENTION, INDICATE WHAT CONTRIBUTION WAS MADE BY EACH INVENTOR.
Joint inventors participated in brainstorming discussions. They have knowledge and/or experience with confocal microscopy and wafer inspection.

9. FEATURES WHICH ARE BELIEVED TO BE NEW.
1. Offset pattern fly-lens array.
2. Binary optics used to make fly-lens array with non-uniform illumination profiles that have been found useful for wafer inspection.

INVENTORS:		
		DATE
		DATE
WITNESSED, READ AND UNDERSTOOD BY:		
(PRINT)	(SIGN)	DATE
(PRINT)	(SIGN)	DATE
(EACH PAGE UPON WHICH INFORMATION IS ENTERED SHOULD BE SIGNED AND WITNESSED) (RETURN COMPLETED FORM TO KEVIN MCANDREWS)		

KLA-Tencor